CLAIMS

What is claimed is:

1. A method of processing data in data services with a set of rate-compatible Turbo Codes optimized at high code rates and derived from a universal constituent code, the Turbo Codes having compatible puncturing patterns, the method comprising the steps of:

encoding a signal at a first and second encoder using a best rate 1/2 constituent code universal with higher and lower code rates, the first encoder and the second encoder each producing a respective plurality of parity bits for a data bit;

puncturing the respective plurality of parity bits at each encoder with a higher rate best puncturing pattern; and

puncturing the respective plurality of parity bits at each encoder with a lower rate best puncturing pattern.

2. The method of Claim 1 wherein the best rate 1/2 constituent code represents a concatenation of polynomial $1+D^2+D^3$ (octal 13) and polynomial $1+D+D^3$ (octal 15), D a data bit.

3. The method of Claim 2 wherein one of the rate-compatible Turbo Codes in the set comprises a rate 1/2 Turbo Code and further wherein one of the puncturings comprises alternately puncturing parity bits between the first and the second encoder.

4. The method of Claim 2 wherein one of the rate-compatible Turbo Codes in the set comprises a rate

1/3 Turbo Code and further wherein one of the puncturings comprises transmitting all the parity bits at the first and second encoder.

5. A method of processing data in data services using a set of rate-compatible Turbo Codes derived from an optimal universal rate 1/3 constituent code, the Turbo Codes having similar constituent codes and compatible puncturing patterns, the method comprising:

encoding a signal with a best rate 1/3 constituent code at a first and a second encoder, each encoder producing a respective plurality of parity bits for each data bit;

puncturing the plurality of parity bits with the a higher rate best puncturing pattern; and

puncturing the plurality of parity bits with a lower rate best puncturing pattern.

6. The method of Claim 5 wherein the best rate 1/3 constituent code represents a concatenation of polynomial $1+D^2+D^3$, (octal 13), polynomial $1+D+D^3$ (Octal 15), and polynomial $1+D+D^2+D^3$ (octal 17), D a data bit.

7. The method of Claim 5 wherein the set of Turbo Codes comprises a rate 1/5 Turbo Code wherein at least one of the steps of puncturings comprises transmitting all the parity bits at the first and the second encoders.

8. The method of Claim 5 wherein the set of Turbo Codes comprises a rate 1/4 Turbo Code wherein at least one of the puncturings comprises:

alternately puncturing a select group of the plurality of parity bits between the first and the second encoder.

9. The method of Claim 5 wherein the set of Turbo Codes comprises a rate 1/3 Turbo Code wherein at least one of the puncturings comprises:

puncturing a select group of the plurality of parity bits at the first and the second encoder.

10. The method of Claim 5 wherein the set of Turbo Codes comprises a rate 1/2 Turbo Code and further wherein at least one of the puncturings comprises:

puncturing at the encoders a select group of the plurality of parity bits and alternately puncturing at the encoders another select group of the plurality of parity bits.

11. A method of rate-compatible Turbo encoding using a set of rate-compatible Turbo Codes, the set optimized for code rate 1/4, and comprising Turbo Codes with differing code rates and rate-compatible puncturing patterns, the method comprising the steps of:

encoding a signal at a first and second encoder using a best rate 1/4 constituent code universal with higher and lower code rates, the first encoder and the second encoder each producing a respective plurality of parity bits for a data bit;

puncturing the respective plurality of parity bits at each encoder with a higher rate best puncturing pattern; and

puncturing the respective plurality of parity bits at each encoder with a lower rate best puncturing pattern.

12. The method of Claim 11 wherein the set of rate-compatible Turbo Codes represent a concatenation of polynomials $1+D+D^3$, $1+D^2+D^3$, and $1+D+D^3$, D a data bit, and wherein an associated rate-compatible puncturing pattern is selected from a group of patterns including:

transmitting all data;

alternately puncturing parity bits associated with polynomial $1+D+D^3$; and

puncturing parity bits associated with polynomial $1+D+D^3$ for each encoder.

13. The method of Claim 11 wherein the set of rate-compatible Turbo Codes comprise two or more Turbo Codes of differing rates selected from a group of rates including 1/5 and 1/4, the Turbo Codes representing a concatenation of polynomials $1+D+D^3$, $1+D^2+D^3$, and $1+D+D^2+D^3$, D a data bit, and wherein an associated rate-compatible puncturing pattern is selected from the group of patterns including:

transmitting all data; and

alternately puncturing parity bits associated with polynomial $1+D+D^2+D^3$.

14. An encoding system using a set of rate-compatible Turbo Codes derived from a best universal rate 1/2 constituent code, the set having compatible puncturing patterns, the system comprising:

a first and second encoder, each encoder comprising:

a plurality of shift registers;

a plurality of adders each adder coupled to a selected portion of the adders in a configuration corresponding to the best universal rate 1/2 constituent code; and

a puncturer configured with the first and second encoder to puncture a plurality of data outputs from each of the first and second encoder, the puncturing determined by a desired Turbo Code rate in accordance with the set of the compatible puncturing patterns.

15. An encoding system using a set of rate-compatible Turbo Codes derived from an optimal universal rate 1/3 constituent code, the rate compatible Turbo Codes having similar constituent codes and compatible puncturing patterns, the system comprising:

a first and second encoder, each encoder comprising:

a plurality of shift registers;

a plurality of adders, each of the adders coupled to a selected portion of the adders in a configuration corresponding to the rate 1/3 constituent code of; and

a puncturer configured with the first and second encoder such to puncture a plurality of data outputs from the first and second encoder, the puncturing determined by a desired Turbo Code rate in accordance with the set of the compatible puncturing patterns.

16. An encoding system using a set of rate-compatible Turbo Codes comprising Turbo Codes having a universal constituent code and rate-compatible puncturing patterns for different code rates, the system comprising:

a first and second encoder, each encoder comprising:

a plurality of shift registers;

a plurality of adders each adder coupled to a selected portion of the plurality of adders in a

configuration corresponding to the universal constituent code; and

a puncturer configured with the first and second encoder for puncturing a plurality of data outputs from the first and second encoder, the puncturing determined by a desired Turbo Code rate in accordance with the set of compatible puncturing patterns.

17. A method of determining a set of rate-compatible Turbo Codes, optimized at high code rates , the set derived from a best universal constituent code of rate 1/2 compatible with higher codes, the Turbo Codes having compatible puncturing patterns, the method comprising the steps of:

selecting a group of candidate mother constituent code pairs comprising primitive, irreducible polynomials based upon code pair screening and diversity, the code pair screening comprising simulating relative Bit Error Rate (BER) performance of rate 1/2 and 1/3 Turbo Codes at a fixed Interleaver length;

measuring an relative Signal-to-Noise ratio loss of a signal after a plurality of encodings for each candidate pair at both a plurality of different Interleaver depths and two different Turbo Code rates, wherein each encoding has a different combination of candidate pair, Interleaver depth, and rate;

selecting a best candidate pair based upon a best relative Signal-to-Noise loss from the measuring; and

selecting at least one lower rate and one higher rate best puncturing pattern for the best candidate pair, for each of the two or more rate-compatible Turbo Codes of the set, wherein the at least one higher rate pattern selects transmittal of any parity

bits selected for transmittal by the at least one lower rate pattern of the set.